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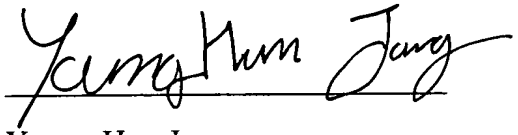

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[Abstract]

[Abstract of the Disclosure]

The present invention provides a batch type atomic layer deposition. Particularly, the batch type ALD apparatus and an in-situ cleaning method thereof supplies a cleaning gas to a central region of an upper plate in a radial form, thereby improving an efficiency on the in-situ cleaning of the batch type ALD apparatus.

[Representative Figure]

Figure 7

[Index]

Batch type atomic layer deposition, ALD, Plasma excitement electrode, Ion extraction electrode, Cleaning, In-situ

[Specification]

[Title of Invention]

Batch type Atomic Layer Deposition and method for insitu-cleaning in the batch type atomic layer deposition

[Brief Description of the Drawings]

Fig. 1 is a schematic diagram showing an atomic layer deposition adopting a traveling wave method according to a prior art.

Fig. 2 is a schematic diagram showing a batch type atomic layer deposition apparatus according to a prior art.

Fig. 3a is a diagram illustrating an in-situ cleaning method using the batch type atomic layer deposition apparatus shown in Fig. 2.

Fig. 3b is a diagram showing a result of the in-situ cleaning according to the in-situ cleaning method shown in Fig. 3a.

Fig. 4 is a diagram showing a structure of a batch type atomic layer deposition apparatus in accordance with a first preferred embodiment of the present invention.

Fig. 5 is a diagram showing a structure of a batch type atomic layer deposition apparatus in accordance with a second preferred embodiment of the present invention.

Fig. 6 is a diagram illustrating an in-situ cleaning

method of the batch type atomic layer deposition apparatus shown in Fig. 4.

Fig. 7 is a diagram illustrating an in-situ cleaning method of the batch type atomic layer deposition apparatus shown in Fig. 5.

- Description of main symbols in Figures

40: reaction chamber 41a: upper plate

41b: lower plate 41c: sidewall

42: radial shower head 43: heating plate

44: rotating axis 45: rotating plate

46: wafer 47: baffle structured exhaust

48: cooling plate 49: plasma excitement electrode

53: ion extraction electrode

[Description of Invention]

[Purpose of Invention]

[Field of the Invention and Description of Related Art]

The present invention relates to an atomic layer deposition (ALD) apparatus; and more particularly, to a batch type ALD apparatus and an in-situ cleaning method thereof.

Recently, an atomic layer deposition (ALD) technique

using a surface reaction is applied to a structure having a high aspect ratio due to a limitation of a chemical vapor deposition (CVD) technique to overcome high aspect ratio.

Fig. 1 is a schematic diagram showing an apparatus for an atomic layer deposition adopting a traveling wave method in accordance with a prior art.

As shown in Fig. 1, the apparatus includes a chamber (10) using the traveling wave method and having a channel-like shape, a wafer (11) is loaded on a bottom of the chamber (10), first and second channels (12a, 12b) for injecting a source gas, a reaction gas and a purge gas being formed on one side of the chamber (10) and a pump (13) for exhausting the gases being equipped on other side of the chamber (10).

In performing the atomic layer deposition adopting the traveling wave method, a series of the following processing steps are proceeded: the wafer (11) is loaded into the chamber (10); a process for a chemical absorption of a source gas (A) is carried out on the wafer (11); the remnant source gas (A) is exhausted by injecting a purge gas like an inert gas; an atomic layer (C) is deposited by injecting a reaction gas (B) and subsequently inducing a surface reaction between the chemically absorbed source gas (A) on the wafer and the reaction gas (B); and the above

inert gas is injected again in order to exhaust the remnant gas and a by-product produced by the surface reaction.

The above series of the processing steps constitute one cycle (1 cycle), and this cycle is repeatedly carried out until obtaining an intended thickness of the atomic layer.

According to the prior art, it is possible to obtain a conformal and uniform film. It is also possible to suppress more effectively a particle generation elicited by a gas phase reaction compared to a chemical vapor deposition (CVD) technique because the source gas and the reaction gas are separated from each other by the inert gas and then, the separated source/reaction gases are supplied into the chamber 10. In addition, induction of multi-collision between the source gas and the wafer improves efficiency on use of the source gas and reduces a cycle duration period.

However, the above-mentioned prior art of which throughput ranges between about 3 WPH (wafer per hour) and about 4 WPH is not suitable for applying it to a mass production system because lots of equipment, an huge space, and a maintenance expense are needed to maintain such system and the above mentioned throughput is not relatively remarkable.

Applicant files a patent application disclosing a batch type atomic layer deposition, shown in Fig. 2, to overcome the above problems. [Referring to the Korean Patent Application No. 10-2002-27614]

As shown in Fig. 2, the batch type atomic layer deposition apparatus consists of the following parts: a reaction chamber (30) including a sidewall (31c), an upper plate (31a), and a lower plate (31b); a hole type shower head (33) for injecting a source gas($TiCl_4$), a reaction gas(NH_3), and a purge gas(Ar) including a cleaning gas (Cl2) by passing through a channeled central region of the upper plate (31a); a heating plate (33) being attached to the lower plate (31B) and being able to control a temperature of any area on a wafer; a rotating axis (34) penetrating through the lower plate (31b) and a central region of the heating plate (33); a rotating plate (35) on which a plurality of wafers (36) are loaded with an identical distance from its center and of witch bottom side is fixed to the rotating axis (34); and a baffle structured exhaust (37) which exhausts the gases injected from the hole-type shower head (32) by passing through the lower plate 31B along the sidewall (31c) adjacent to an edge area of the rotating plate (35). A groove (35a) used for loading the wafer is formed on a surface of the rotating

plate (35), wherein the groove prevents an atomic layer from being deposited on a bottom side of the wafer and tightens the wafer so as not to be shaken during the rotation. Herein, $TiCl_4$, NH_3, Ar and Cl_2 are used as a source gas, a reaction gas, a purge gas and a cleaning gas, respectively.

In addition, the heating plate (33) is divided into three heating zones, that is, Z_1, Z_2 and Z_3 on which wafers are symmetrically loaded around the central region of the heating plate (33). Each of the heating zones has a ring type arc lamp (33a) arranged with a constant distance.

More specifically, the heating plate (33) is located right under the rotating plate (35), a first heating zone (Z_1) most closely adjacent to the shower head (32) among the three heating zones has three arc lamps (33a), a third heating zone (Z_3) most closely adjacent to the rotating plate (35) has one arc lamp, and the second heating zone Z_2 existing between the first heating zone Z_1 and the third heating zone Z_3 has two arc lamps (33a).

The batch type atomic layer deposition apparatus shown in Fig 2 has some advantages in terms of an atomic layer deposition rate and uniformity. In case of reducing the cycle period, a process throughput of a TiN layer deposition increases by about 12 WPH.

A process for cleaning an inside surface of the reaction chamber is carried out: after the TiN deposition is performed by using the atomic layer deposition apparatus, the cleaning of the inside surface of the reaction chamber, namely in-situ cleaning, is proceeded from a center hole of the shower head 32 by using a gas supplier which rapidly inject Cl_2 gas supplied through a $TiCl_4$ gas line (32a). This in-situ cleaning of the batch type atomic layer deposition apparatus impedes an underside of the loaded wafer from being deposited with the TiN layer and prevent a particle generation within the groove (35a) [commonly named as susceptor] for tightening the loaded wafer. Therefore, the in-situ cleaning process is a requisite of the atomic layer deposition apparatus for a mass production.

Fig 3a shows an in-situ cleaning method in accordance with the prior art.

Referring to Fig. 3a, Cl_2(800sccm)/Ar(800sccm) gas continuously flows into a central area of the reaction chamber through the hole type shower head (32) from a first and a second gas line (32a, 32b). Furthermore, the Cl_2 gas is more densely distributed around a center area of a body of the Cl_2 gas and cleans the TiN layer deposited on the rotating plate (35) and the susceptor (35a) by thermally dissolving it while the Cl_2 gas spreads out in a radial

form. Another gas line is prepared for forcing Ar gas to flow along an underside surface of the rotating plate (45) for preventing the deposition from being taken place at the underside surface.

As shown in Fig. 3b, a peripheral area of the rotating plate (35) and the susceptor (35a) is easily cleaned while the in-situ cleaning is carried out, however a TiN layer deposited on the center area of the rotating plate (35) is not easily cleaned because the deposited TiN layer has a topologically different thickness, like a ring pattern (38) formed on the deposited TiN layer due to the topologically different thickness still remains during the in-situ cleaning process as shown in Fig. 3b.

Fig. 3c and 3d are photographs showing a rotating plate responsive to a location; while it is effective to clean a peripheral region of the rotating plate (35) and the susceptor (35a) (Fig. 3c), the ring pattern (38) is made since the center area of the rotating plate (35) is not well cleaned.

According to an X-ray examination of the remnant layer having the ring pattern, there is no peak of any other crystal structure as well as Tin crystal structure. From this, it is known that the deposited TiN layer may have an amorphous structure.

Actually, a reaction between the TiN layer and Cl_2 gas should be elicited and the TiN layer should be dissolved into by-products of the reaction ($TiCl_4$, N_2). Thereafter, the by-products should be detached and pumped out. However, as a matter of a fact, a bamboo or tall grass type by-product is formed and remains on the central area of the rotating plate (35).

The ring pattern is not removed even though the rotating plate (35) is heated to about 450℃ and ALD process parameters such as an amount of $TiCl_4/Ar/NH_3$ gas, a cycle period, and a distance between the rotating plate (35) and the upper plate (31a) are adjusted. Actually, these treatments remove a partial portion of the ring pattern, not the whole pattern.

There are several factors causing this technical problem. First of all, the Cl_2 gas is supplied only to the central area of the rotating plate, and the excessive Cl_2 gas supply to the central area prevents the generated by-products from being detached. As a result, the by-products are re-deposited. Compared with a shower head type apparatus supplying gas uniformly on an entire surface of a wafer, the batch type atomic layer deposition apparatus supplies all gases from the central area of the upper plate (31a).

Therefore, a level of impurities, usually metal elements formed on the central area of the loaded wafer, is higher than on other areas. Consequently, the generated by-products are not easily removed even though there occurs the reaction between the Cl_2 gas and the by-products.

[Technical object achieved by Invention]

It is, therefore, an object of the present invention to provide a batch type atomic layer deposition (ALD) apparatus capable of improving a cleaning efficiency by supplying a cleaning gas to a central area of an upper plate in a radial form and an in-situ cleaning method thereof.

[Detailed Description of Invention]

In accordance with an aspect of the present invention, there is provided the batch type atomic layer deposition apparatus, including: a reaction chamber having a predetermined volume constituted with an upper plate, a lower plate and sidewalls; a rotating plate loaded with a plurality of wafers, wherein each wafer is located in the reaction chamber and loaded radially at a predetermined position disposed in an identical distance from a center of the rotating plate; a radial shower head for forcing a gas

to flow toward an upper surface of the wafer as passing through a center of the upper plate, wherein the radial shower head faces a center of an upper surface of the rotating plate; a heating plate having a heating zone capable of controlling a temperature of any area and being located on the lower plate with a predetermined distance of the rotating plate; a cooling plate attached to an upper surface of the upper plate; and a plasma excitement electrode encompassing an entrance of the radial shower head by being located between the cooling plate and the entrance of the radial shower head.

Hereinafter, a batch type atomic layer deposition (ALD) apparatus in accordance with the best mode of the present invention will be described referring to the accompanying drawings so that people skilled in the art easily understands the subject matter of the invention.

Fig 4 is a diagram showing a structure of a batch type atomic layer deposition apparatus according a first embodiment of the present invention.

Referring to Fig. 4, the batch type ALD apparatus includes a reaction chamber (40) containing sidewalls (41c), an upper plate (41a), and a lower plate (41b); a radial shower head (42) penetrating a center area of the upper plate (41a) of the reaction chamber (40) and radially

injecting a source gas, a reaction gas, a purge gas, wherein the gases are supplied through a first and a second gas injection line (42a, 42b); a heating plate (43) attached to the lower plate (41b); a rotating axis (44) penetrating a center of the lower plate (41b) and the heating plate (43) simultaneously; a rotating plate (45) on which a plurality of wafers (46) are loaded in an radial form with an identical distance from a center of the rotating plate (45), wherein a center of bottom surface of the rotating plate (45) is fixed at the rotating axis (44); a baffle structured exhaust (47) for exhausting the gases injected from the radial shower head (42), wherein the exhaust penetrates the heating plate (43) and the lower plate (41b) along the sidewall most closely adjacent to an edge area of the rotating plate (45); a cooling plate (48) attached to the upper plate (41a); and a plasma excitement electrode (49) having a ring shape and encompassing an entrance of the radial shower head by being located between the cooling plate (48) and the entrance of the radial shower head (42). Herein, the plasma excitement electrode (49) is supplied with a RF (radio frequency) power. Herein, the plasma excitement electrode (49) excites Cl_2/Ar gas as a cleaning gas to plasma and forms a Cl_2 radical. Consequently, a reaction between the Cl_2 radical containing

activated molecules and a deposited TiN layer is expedited.

Fig. 5 is a diagram showing a batch type ALD apparatus according to a second embodiment of the present invention.

Referring to Fig. 5, the batch type ALD apparatus includes: a reaction chamber (40) containing sidewalls (41c), an upper plate (41a), and a lower plate (41b); a radial shower head (42) penetrating a central area of the upper plate (41a) of the reaction chamber (40) and radially injecting a source gas, a reaction gas, a purge gas, wherein the gases are supplied through a first and a second gas injection line (42a, 42b); a rotating axis (44) on which a plurality of wafers (46) are loaded in a radial form with an identical distance from a center of the rotating plate (45), wherein a center of bottom surface of the rotating plate (45) is fixed at the rotating axis (44); a baffle structured exhaust (47) for exhausting the gases injected from the radial shower head (42), the exhaust (47) penetrates the heating plate (43) and the lower plate (41b) along the sidewall (41c) most closely adjacent to an edge area of the rotating plate (45); a cooling plate (48) attached to the upper plate (41a); a plasma excitement electrode (49) having a ring shape and encompassing an entrance of the radial shower head (42) by being located

between the cooling plate (48) and the entrance of the radial shower head (42); an ion extraction electrode (53) encompassing an discharging vent of the radial shower head 42 by being located between the upper plate (41a) and the discharging vent of the radial shower head (42). Herein, the plasma excitement electrode is supplied with a RF power; and an ion extraction electrode (53) encompassing discharging vent of the radial shower head (42) by being located between the upper plate (41a) and the discharging vent of the radial shower head (42). Herein, the ion extraction electrode (53) is used for extracting Cl^- ions from Cl_2 molecules injected through a gas injection line (42b).

In conclusion, in Fig. 5, the plasma excitement electrode (49) and the ion extraction electrode (53) are aids for cleaning a remnant TiN layer, owing to a fact that both of the plasma excitement electrode (49) and the ion extraction electrode (53) ionize the Cl_2 molecules and the formed Cl^- ions are used for the cleaning process.

In Figs. 4 and 5, the radial shower head (42) or corn typed shower head improves uniformity of the deposition compared to the hole typed shower head, and the cooling plate (48) prevents the upper plate (41a) from being deposited by any gas.

In addition, the heating plate (43) includes three heating zones, that is, a wafer heating area for depositing the atomic layer is divided into three heating zones Z_1, Z_2, Z_3. Each of the heating zones has an arrangement of a ring typed arc lamp (43a) with a constant distance.

In more detail, the heating plate (43) is located right under the rotating plate (45). Among the three heating zones, a first heating zone (Z_1) most closely adjacent to the radial shower head (42) has three arc lamps (43a). A third heating zone (Z_3) most closely adjacent to an edge area of the rotating plate (45) has one arc lamp (43a), and a second heating zone (Z_2) has two arc lamps is located between the first heating zone (Z_1) and the third heating zone (Z_3).

Accordingly, a temperature of each heating zone is varied by controlling a power rate of the arc lamps (43a). For example, the power rate of the arc lamp of the first heating zone (Z_1) is increased more than that of the arc lamp of the second heating zone (Z_2) while the power rate of the arc lamp of the third heating zone (Z_3) is decreased more than that of the arc lamp of the second heating zone (Z_2). Contrarily, the power rate of the arc lamp (43a) of the first heating zone (Z_1) may be decreased while the power rate of the arc lamp (43a) of the third heating zone

(Z_3) may be increased. Furthermore, the power rate of the arc lamp (43a) is a parameter for deciding a deposition temperature of the wafer when an atomic layer is deposited on the wafer (46) and a setting temperature of the arc lamp is a target temperature at which the atomic layer is deposited on the wafer (46).

A groove (45a), commonly named as susceptor for loading and tightening the wafer (46) on the rotating plate (45) is prepared for preventing the atomic layer from being deposited on an underside of the wafer (46) and tightening the wafer (46) to prevent it from being shaken when the rotating plate (45) is rotated.

When the source gas, reaction gas, purge gas, and cleaning gas are supplied from the center of the upper plate (41a), that is, the radial shower head (42), a traveling wave flow of the supplied gas is formed in outward direction from the rotating plate (45), and eventually, the gases are pumped out from the reaction chamber (40) through the exhaust (47) of the rotating plate (45).

In addition, the rotating plate (45) is rotated so as to obtain enhanced deposition uniformity and load the wafer thereon, and an inert gas, that is, Ar gas, always flows along the bottom surface of the rotating plate (45) to

prevent the atomic layer from being deposited thereon. At this time, the inert gas flowing along the bottom surface of the rotating plate (45) is supplied externally through an extra gas injection line even if not illustrated.

As mentioned above, uniformity of sheet resistance of a TiN layer is obtained through the followings: the gases are supplied from the center of the reaction chamber (40) through the radial shower head (42); a plurality of wafers are loaded on the rotating plate; and the wafer (46), on which the atomic layer is deposited, is divided into the three heating zones Z_1, Z_2 and Z_3 and each temperature of the three heating zones is controlled.

Instead of maintaining a temperature consistently throughout the whole region of the wafer (46), the heating plate (43) arranged with the ring type arc lamp (43a) controls the power rate of each heating zone to be varied to have a different temperature distribution.

Fig. 6 is a diagram showing a method for an in-situ cleaning of the batch type ALD apparatus illustrated in Fig. 4.

Referring to Fig. 6, after depositing a TiN layer (50a) on the wafer (46), a process for cleaning a remnant TiN layer (50b) remaining on a central area of the rotating plate (45) is carried out.

First, cleaning gases are injected through the first and the second gas injection line (42a, 42b) for injecting the source gas, reaction gas, and purge gas. Herein, the cleaning gases are Ar and Cl_2 and each of the cleaning gases is injected through each gas injection line separately. In more detail, the Ar gas is injected at a flow rate of about 500 sccm to about 1000 sccm while Cl_2 gas is injected at a flow rate of about 200 sccm to about 800 sccm. It is also possible to control each gas flow rate according to a stability condition of plasma.

After that, a RF power ranging from about 100 W to about 600 W and having a frequency of 13.56 MHz is applied to the plasma excitement electrode when the cleaning gases pass through the radial shower head (42) and a plasma state is created by the cleaning gases being excited at a pressure of about 1 torr to about 20 torr. Consequently, Cl_2 radicals, that is, the Cl_2 radicals mean activated Cl_2 molecules, are formed.

The activated Cl_2 molecules (51) are supplied in an radial form and intensively react with the remnant TiN layer (50b) deposited on the central area of the rotating plate (45).

In other words, the reaction between the activated Cl_2 molecules (51) and the remnant TiN layer (50b) is

expedited by the activated Cl_2 molecules (51), and some by-products ($TiCl_4$, N_2) are generated by the reaction. Eventually, the by-products are pumped out without any difficulty because the by-products are easily detached from the center area of the rotating plate (45).

As mentioned above, the by-products are easily detached because the activated Cl_2 molecules (51) are injected in the radial form through the radial shower head (42) and the injected activated Cl_2 molecules are supplied broadly to the central area of the rotating plate (45) broadly and uniformly during the cleaning process as shown in Fig. 6. In short, the generated by-products are easily detached because the activated Cl_2 molecules are not supplied intensively only to the central area of the rotating plate (45). Moreover, the above-described characteristic gas flow prevents the re-deposition phenomenon.

Fig. 7 is a diagram showing a method for the in-situ cleaning of the ALD apparatus illustrated in Fig. 5.

Referring to Fig. 7, the cleaning process for removing a remnant TiN layer (50b) remaining on the central area of the rotating plate (45) is carried out after depositing the TiN layer (50a) on the wafer (46).

First, the cleaning gas is injected through the first

and second gas injection line (42a, 42b) for injecting the source, reaction, and purge gas. At this time, Ar and Cl_2 gases are used as the cleaning gas, and injected through each gas injection line (42a, 42b) separately. Specifically, the Ar gas and the Cl_2 gas are injected at a flow rate of about 500 sccm to about 1000 sccm and about 200 sccm to about 800 sccm respectively. It is also possible to control each flow rate according to a stability state of plasma.

Next, when the cleaning gas is passed through the radial shower head (42), a RF power (13.56MHz) of about 100W to about 600W is supplied to the plasma excitement electrode 49; and when Cl_2/Ar gases inserted through the gas injection lines (42a, 42b) flow, activated Cl_2 is formed by a plasma excitement process. During the plasma excitement process, a pressure in the reaction chamber is controlled in a range of about 1 torr to about 20 torr

Next, a large quantity of Cl^- ions are generated by applying a DC voltage, that is, ion extraction voltage, of about 500 V to about -50 V to the ion extraction electrode (53). Meanwhile, an electrical lens effect (54) occurs when the Cl^- ions, which are generated by the ion extraction electrode (53) located in the radial shower head (42), starts flowing, and an accelerated ion trajectory

(55) of the Cl^- ions is fomed by the electrical lens effect (54).

In short, the Cl^- ions are accelerated toward the rotating plate (45) along the accelerated ion trajectory (55) and the accelerated Cl^- ions remove the remnant TiN layer (50b) easily. Herein, the removal of the TiN layer (50a) is caused by a sputtering effect of the Cl^- ions.

Consequently, the in-situ cleaning method using the Cl_2 gas shows an improvement because both of a chemical etching and a physical etching are carried out simultaneously. To obtain the sputtering effect mentioned above, in other words, to broaden a sputtering target area, an angle (α) of the exhaust (47) of the radial shower head (42) is increased and a distance d between the upper plate (41a) and the rotating plate (45) is adjusted.

For example, an angle (α) of about 120° to about 160° is most suitable for the exhaust (47) of the shower head (42), and a target area of the in-situ cleaning is adjusted by controlling the accelerated ion trajectory (55) of the Cl^- ions extracted by applying the DC voltage to the ion extraction electrode (52).

If the angle (α) of the exhaust (47) of the shower head (42) is more than about 160°, the accelerated ion trajectory (55) of the extracted Cl^- ions becomes broad and

the sputtering target area is also broadened. However, an efficiency on the in-situ cleaning is reduced because a density of the accelerated ions is decreased. In contrary, if the angle (α) of the exhaust (47) of the shower head (42) becomes less than about 120°, the accelerated ion trajectory (55) of the extracted Cl^- ions becomes narrow and the sputtering target area also becomes narrow. However, the efficiency on the in-situ cleaning is also reduced because the sputtering target area is too narrow.

In addition, the distance D between the radial shower head (42) and the rotating plate (45) is kept up at about 3.5mm to about 7mm. In conclusion, the efficiency on the in-situ cleaning is considerably improved by adjusting the angle (α) of the exhaust (47) of the radial shower head (42) and the distance D between the radial shower head (42) and the rotating plate (45) on condition that these adjustments do not affect properties of the TiN layer (50a) such as sheet resistance Rs and thickness uniformity.

The above preferred embodiments describe the in-situ cleaning performed after finishing the TiN layer deposition. The present invention can be also applied to a case of depositing other material such as SiN, NbN, TiN, TaN, Ya_3N5, AlN, GaN, WN, BN, WBN, WSiN, TiSiN, TaSiN, AlSiN, AlTiN, Al_2O_3, TiO_2, HfO_2, Ta_2O_5, Nb_2O_5, CeO_2, Y_2O_3, SiO_2, In_2O_3, RuO_2,

IrO_2, $SrTiO_3$, $PbTiO_3$, $SrRuO_3$, $CaRuO_3$, Al, Cu, Ti, Ta, Mo, Pt, Ru, Ir, W, or Ag, wherein such nitrides, metal oxide and metal mentioned above are applied to form a gate oxide layer, a gate electrode, an upper/lower electrode for a capacitor, a dielectric layer, a diffusion barrier layer, a metal wire and so on.

In addition, the batch type ALD deposition apparatus according to the present invention has a large volume of reaction chamber in which four 200 mm wafers can be loaded at once. In case of loading 300 mm wafer, it is possible to load three 300 mm wafers without changing any process parameter.

Although the preferred embodiment of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

[Effect of Invention]

The present invention has an advantage for achieving an effective batch type atomic layer deposition, enhancing a productivity of in-situ cleaning, and reducing a fabrication cost.

Also, since a condition for the in-situ cleaning is applied to a method according to the present invention, it can be faster to load 300 mm wafer.

Further, since the present invention can be applied to a conventional fabrication process of semiconductor device, an in-situ cleaning for use in the batch type atomic layer deposition is generally used.

[Claims]

1. A batch type atomic layer deposition apparatus, comprising:

a reaction reaction chamber having a predetermined volume constituted with an upper plate, a lower plate and sidewalls;

a rotating plate loaded with a plurality of wafers, wherein each wafer is located in the reaction chamber and loaded radially at a predetermined position disposed in an identical distance from a center of the rotating plate;

a radial shower head for forcing a gas to flow toward an upper surface of the wafer as passing through a center of the upper plate, wherein the radial shower head faces a center of an upper surface of the rotating plate;

a heating plate having a heating zone capable of controlling a temperature of any area and being located on the lower plate with a predetermined distance of the rotating plate;

a cooling plate attached to an upper surface of the upper plate; and

a plasma excitement electrode encompassing an entrance of the radial shower head by being located between the cooling plate and the entrance of the radial shower

head.

2. The batch type atomic deposition apparatus as recited in claim 1, further comprising an ion extraction electrode encompassing an exhaust of the radial shower head located between the exhaust of the radial shower head and the upper plate.

3. The batch type atomic deposition apparatus as recited in claim 2, wherein the ion extraction electrode is supplied with a DC voltage.

4. The batch type atomic deposition apparatus as recited in claim 1, wherein the plasma excitement electrode is constructed in a ring type structure and supplied with a RF power.

5. The batch type atomic deposition apparatus as recited in claim 1, wherein the exhaust of the radial shower head has an angle ranging from about 120° to about 160°.

6. The batch type atomic deposition apparatus as recited in claim 1, wherein a separating distance between

the radial shower head and the rotating plate ranges from about 3.5 mm to about 7 mm.

7. A method for an in-situ cleaning of a batch type atomic layer deposition apparatus of claim 1, the method comprising the steps of:

depositing an atomic layer on a wafer;

injecting a cleaning gas into a radial shower head;

applying a RF power to a plasma excitement electrode when the cleaning gas passes through the radial shower head; and

inducing a reaction between the cleaning gas activated by the plasma excitement electrode and a remnant atomic layer on a rotating plate.

8. The method as recited in claim 7, wherein the RF power of about 100 W to about 600 W is applied to the plasma excitement electrode.

9. The method as recited in claim 7, wherein the cleaning gas is a mixture of Cl_2 gas and Ar gas, however each gas is injected separately.

10. A method for an in-situ cleaning of a batch type

atomic layer deposition apparatus of claim 2, the method comprising the steps of:

depositing an atomic layer on a wafer;

injecting a cleaning gas into a radial shower head;

creating an activated molecule of a cleaning gas through applying a RF power to a plasma excitement electrode;

ionizing an activated molecule by applying an ion extraction voltage to an ion extraction electrode; and

inducing a collision between the ionized molecule and a remnant atomic layer of a rotating plate.

11. The method as recited in claim 10, wherein the ion extraction voltage applied to the ion extraction electrode ranges from about -500 V to about -50 V.

12. The method as recited in claim 10, wherein the RF power applied to the plasma excitement electrode ranges from about 100 W to about 600 W.

13. The method as recited in claim 10, wherein the cleaning gas is a mixture of Cl_2 gas and Ar gas, and each gas is injected separately.